Quench Location in Superconducting Radio-Frequency Cavities

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Superconducting radio-frequency (SRF) cavities are the accelerating components for the next generation of particle accelerators. Unlike the normal-conducting cavities, the SRF cavities, in principle, can stand a high electric field gradient (up to 60 MV/m for pure niobium) with very low dissipation of the RF power. Cavities that perform at the accelerating gradient of 30-35 MV/m are the current state of the art. Since the cavities installed in an accelerator must demonstrate no quenches during routine high-gradient operation, limitations to such performance must be identified and removed entirely during their manufacture and testing. Such quenches can be detected in a cold test where the cavity is kept in a superfluid helium (Helium II) bath at about 2 Kelvin and instrumented with oscillating superleak transducers (OSTs) and resistance thermal detectors (RTDs). Using the position of the transducers around the cavity and time delays for second sound signal generated by a quench to reach each of the transducers, we used a method called trilateration to calculate the location of the quench. In order to be able to perform real-time calculations for large numbers of cavities, a program based on LabVIEW was also developed. We were able to locate the quench by this method and verify our results with the complementary experimental observations obtained from RTDs.